RETRACTABLE SYRINGE

Field of the Invention

This invention relates to a retractable syringe.

Background of the Invention

International patent application PCT/AU01/00341 (WO 01/72363) discloses a retractable syringe having a barrel, with a front end and a rear end, that defines a receptacle for containing a liquid for injection. The syringe also has a needle mounted at the front end of the barrel and a hollow plunger movable within the barrel from the rear end to the front end of the receptacle, to expel fluid out of the barrel through the needle. The plunger has an inner chamber, an axial hole at the front end of the chamber and means blocking the axial hole. The syringe also has resilient means adapted to urge the needle in a rearward direction into the barrel. The resilient means is restrained by an expandable annular member providing a seal at the front end of the receptacle of the barrel. The expandable annular member is engaged by a forward part of the plunger when the plunger reaches the front end of the receptacle of the barrel, such that the expandable annular member moves along a surface at the front end of the barrel and expands to release the resilient means. When this release occurs, the axial hole is unblocked and the needle is automatically retracted through the axial hole into the inner chamber of the plunger.

Retractable syringes constructed in accordance with the above have been found to operate effectively. However, the needle does tend to be advanced with the resilient means, when the resilient means is engaged by the forward part of the plunger. This arises because the resilient means maintains resilient gripping of the needle during initial movement of the latter, that is until sufficient movement has occurred that the resilient means no longer effectively grips the needle. While some degree of forward movement may be generally acceptable, substantial movement is at least inconvenient, possibly resulting in increased patient penetration by the needle unless some care is exercised by the person using the syringe.

Another disadvantage of retractable syringes of the general kind where the needle is retracted into a plunger chamber arises from the need to provide a hole at the end of the plunger chamber, that faces the needle, to enable entry of the needle into the

chamber. Unless this hole is closed for at least most of the movement of the plunger towards the needle end of the syringe, significant amounts of the syringe fluid may be taken into the chamber, rather than being expressed through the needle. As described in international application PCT/AU01/00341, prevention of ingress into the chamber may be achieved by use of a plug which normally blocks the hole, but which is displaced into the chamber as the plunger is brought into engagement with the needle, so as to leave the hole open for entry of the needle. In production, the provision and fitting of a separately formed plug of this kind is inconvenient, requiring separate forming and assembly steps.

It is an object of the present invention to substantially overcome or at least ameliorate one or more of the prior art deficiencies.

Summary of the Invention

Accordingly, in a first aspect, the present invention provides a retractable syringe having:

a barrel having a front end, a rear end and defining a receptacle for containing a liquid for injection;

a needle mounted at the front end of the barrel;

a hollow plunger movable within the barrel from the rear end to the front end of the receptacle to expel fluid out of the barrel through the needle;

said plunger having an inner chamber, an axial hole at the front end of the chamber and means blocking the axial hole;

resilient means which is adapted to urge the needle in a rearward direction into the barrel;

wherein said resilient means is restrained by an expandable annular member providing a seal at the front end of the receptacle of the barrel;

the expandable annular member being engaged by a forward part of the plunger when the plunger reaches the front end of the receptacle of the barrel such that the expandable annular member moves along a surface at the front end of the barrel and expands to release the resilient means, whereby the axial hole is unblocked and the needle is automatically retracted through the axial hole into the inner chamber of the plunger, wherein the resilient means in its restrained condition limits movement of the needle under said movement of the expandable annular member to release the resilient means.

Where the resilient means is a compression spring, this result may be achieved by arranging that the spring is at least substantially fully compressed when restrained by the expandable annular member, prior to said engagement by the forward end of the plunger. By this, the expandable annular member is moved with respect to the needle to effect release.

In a second aspect, the present invention provides a retractable syringe having:

a barrel having a front end, a rear end and defining a receptacle for containing a liquid for injection;

a needle mounted at the front end of the barrel;

a hollow plunger movable within the barrel from the rear end to the front end of the receptacle to expel fluid out of the barrel through the needle;

said plunger having an inner chamber, an axial hole at the front end of the chamber and means blocking the axial hole;

resilient means which is adapted to urge the needle in a rearward direction into the barrel;

wherein said resilient means is restrained by an expandable annular member providing a seal at the front end of the receptacle of the barrel;

the expandable annular member being engaged by a forward part of the plunger when the plunger reaches the front end of the receptacle of the barrel such that the expandable annular member moves along a surface at the front end of the barrel and expands to release the resilient means, whereby the axial hole is unblocked and the needle is automatically retracted through the axial hole into the inner chamber of the plunger, wherein the blocking means is engaged and at least partly broken from the plunger by engagement of the plunger with the needle.

The blocking means may be positioned at the end of the plunger facing the needle, or within the plunger, such as within the chamber or a passageway in the plunger leading to the chamber.

In one form, the plunger and the blocking means are integrally formed. For example the blocking means may be formed as a transverse wall member which is joined to the inner periphery of the hole by a region of weakness, such that breaking occurs at that region. The wall may be joined around its perimeter to the inner periphery of the hole, for example at the forward end of the hole, or within the hole.

In another form, the plunger and the blocking means are discrete components connected together. For example, the blocking means is formed as a forwardly convex member positioned on the leading end of the plunger, the convex member including a region of weakness forward of the plunger, such that breaking occurs at the region. The convex member is preferably formed of a material relatively more brittle than that of the plunger.

For production reasons, the mentioned chamber usually needs to be formed so as to be open at the end remote from the part of the plunger that engages the needle, so that the chamber is correspondingly open at that end, whereas the chamber needs to be closed at that end to prevent any syringe liquid that may pass into the chamber when the other end of the chamber is opened to allow the needle to pass into the chamber from exiting the syringe.

In a third aspect, the present invention provides a retractable syringe having:

a barrel having a front end, a rear end and defining a receptacle for containing a liquid for injection;

a needle mounted at the front end of the barrel;

a hollow plunger movable within the barrel from the rear end to the front end of the receptacle to expel fluid out of the barrel through the needle;

said plunger having an inner chamber, an axial hole at the front end of the chamber and means blocking the axial hole;

resilient means which is adapted to urge the needle in a rearward direction into the barrel;

wherein said resilient means is restrained by an expandable annular member providing a seal at the front end of the receptacle of the barrel;

the expandable annular member being engaged by a forward part of the plunger when the plunger reaches the front end of the receptacle of the barrel such that the expandable annular member moves along a surface at the front end of the barrel and expands to release the resilient means, whereby the axial hole is unblocked and the needle is automatically retracted through the axial hole into the inner chamber of the plunger,

wherein the chamber is closed at said remote end by entry thereinto of plug elements formed integrally with the plunger.

Preferably, the plug elements are attached to the body of the plunger by swingable elements which can be swung from a position at which they extend sidewardly and outwardly of the body to positions at which these extend inwardly such that parts of the plug formed on each come together to form the plug, with the so formed plug then closing said opening.

In a fourth aspect, the present invention provides a method of forming a barrel structure for a retractable syringe, said barrel structure adapted for use with a syringe plunger having a body with an internal inner chamber, the syringe plunger having a plunger opening at a forward end thereof and communicating with said inner chamber, said plunger opening being formed in a forward abutment portion of the plunger, said plunger being adapted to be slidingly and sealingly accommodated in the barrel structure, for expressing fluid from a forward end of the barrel structure; the method including:

a) forming said barrel structure as a syringe barrel having a cylindrical barrel interior, said barrel having a transverse closure portion at a forward end and being open at an opposite rear end, said closure portion having a needle accommodating opening therethrough, said needle accommodating opening having a first portion open to a forward end of the barrel, and a second portion communicating with the cylindrical barrel interior, said second portion being of greater transverse size than said first portion;

b) forming a hollow fluid conducting needle structure having an elongate needle having a forward skin penetration end and, remote but spaced from an opposite rearward end, an outwardly extending abutment portion, the needle structure being dimensioned such that it can pass into said inner chamber of said syringe plunger from said needle accommodating opening;

c) forming a helical compression spring having an outer diameter greater than the transverse size of said first portion of the needle accommodating opening, less than the transverse size of said second portion of the needle accommodating opening, and less than the transverse size of the plunger opening to permit the spring to enter the said inner chamber with said needle structure, when the plunger is positioned in the syringe barrel, the inner diameter of the spring being smaller than the outer transverse size of the needle

structure at said abutment portion, said spring having a compressed state beyond which further compression is at least substantially inhibited;

d) forming a resilient O-ring having in a compressed state an internal diameter such as to resiliently grip an end portion of the needle structure, between the abutment and a rear end of the needle structure, when the O-ring is positioned over the end portion, such as to substantially inhibit relative movement between the O-ring and the needle structure, but which diameter in the compressed state is less than said side to side dimension of the needle structure at said abutment portion, so that passage of the O-ring over the abutment portion is inhibited, at least in the uncompressed state of the O-ring; the O-ring in an uncompressed state having an inside diameter such as not to substantially inhibit said movement of the O-ring relative to the needle structure, when the O-ring is positioned over said end portion of the needle structure;

e) forming an annular retaining structure having an outer surface portion adapted to axially slidingly and sealing engage the surface of the cylindrical barrel, a forward transverse surface adapted to sealingly engage an inner face of said closure portion, and a retaining structure opening therethrough extending from said forward transverse surface to a rear transverse surface of the retaining structure, said retaining structure opening having a first portion opening to said forward transverse surface, having a transverse size such as to accommodate said O-ring in said uncompressed state, a second portion of diameter less than the external diameter of said O-ring in said compressed state and greater than the transverse size of said abutment portion of said needle structure but such as to permit passage of said needle structure and said spring therethrough, and an intermediate portion between said first and second portions, adapted to retain said O-ring therein in said compressed state;

f) assembling said spring, said needle structure, said O-ring and said retaining structure in said barrel by entering these into said barrel from said rear end whereby the penetration end of the needle is passed through said needle accommodating opening in said closure portion to forwardly project therefrom, and the spring is accommodated in said second portion of said needle accommodating opening in abutment with a step between the first and second portions of the needle accommodating opening, and extends into said first portion of said retaining structure opening, and with the needle structure extending through said spring, said O-ring being between said abutment portion and a step between the first and intermediate portions, of said retaining structure opening;

g) during said assembling, said retaining structure being advanced towards said

forward end of the barrel so as to substantially engage the inner face of said closure portion, compress said spring substantially to its compressed state, and cause said O-ring to be retained between said abutment portion and a step in the retaining structure opening, while leaving an annular gap between the periphery of the abutment portion and a peripheral edge of said step, whereby the needle structure may be urged by said spring acting against said abutment portion to pass rearwardly through said retaining structure opening and into said inner chamber via said plunger opening, by advancing said plunger in the barrel such that said abutment portion of the syringe plunger enters said second portion of said retaining structure opening to express said O-ring through said gap into said first portion of the retaining structure opening, to effect release of said gripping.

The step of forming the syringe barrel may be effected by forming said barrel and said closure portion as an integral component.

The plunger may be formed by:

a) forming said body portion;

b) forming a seal member adapted to be retained on a forward end portion of said body portion and to axially slidingly and sealing engage the surface of the cylindrical barrel;

c) assembling said seal member to said body portion such that it surrounds the forward end portion of the body portion, but spaced from the forward end of the body portion so that a projection portion of the body portion defines said abutment;

In a fifth aspect, the present invention provides a retractable syringe formed by assembling a plunger formed by the method of the invention into a barrel structure formed by the method of the invention.

In a sixth aspect, the present invention provides a barrel structure for a syringe having a forwardly extending needle structure which is retractable into the interior of the syringe under influence of a spring which is released from a loaded condition by displacement of a holding means by forward movement of a plunger of the syringe, the resilient means in the loaded condition inhibiting substantial forward movement of the needle structure when the plunger is moved to displace the holding means.

In a seventh aspect, the present invention provides a retractable syringe having a forwardly extending needle structure which is retractable into a chamber in a plunger of the syringe under influence of a spring which is released from a loaded condition by displacement of a holding means, by forward movement of the plunger, the plunger having a forward opening for passage of the needle structure into said chamber, said opening being closed by a frangible wall which is contacted by the needle structure pursuant to said movement of the plunger such that the wall is displaced to permit the needle to enter the chamber.

In an eighth aspect, the present invention provides a retractable syringe having a forwardly extending needle structure which is retractable into a chamber in a body of a plunger of the syringe under influence of a spring which is released from a loaded condition by displacement of a holding means by forward movement of the plunger, the plunger having a forward opening for passage of the needle structure into said chamber, said plunger chamber being closed at an end of the plunger remote from said forward opening by plug elements that are integrally formed with the plunger.

Brief description of the drawings

The invention will now be described in more detail, by way of examples only, with reference to the accompanying drawings, in which:

Figure 1 is an axial cross section of a first embodiment of a retractable syringe constructed in accordance with the invention, in a condition for use;

Figure 2 is a view like Figure 1, but illustrating the syringe in a condition at initiation of retraction of a needle structure of the syringe;

Figure 3 is a view like Figure 1, but illustrating the syringe in a condition at which a needle structure of the syringe is retracted;

Figure 4, 5 and 6 are views like Figure 1, but illustrating movements of components of the syringe occurring during retraction of the needle structure;

Figure 7 is an enlarged view of the region "B" in Figure 1;

Figure 8 is a cross-section on the line 8-8 in Figure 1;

Figure 9 is a cross-section on the line 9-9 in Figure 1;

Figure 10 is a fragmentary axial section of the rear end of a second embodiment of a syringe constructed in accordance with the invention, at a stage during manufacture of the syringe plunger;

Figure 11 is a view like Figure 11, but illustrating the syringe plunger in condition for use; and

Figure 12 is a axial cross-section of a third embodiment of a retractable syringe constructed in accordance with the invention, in an exploded condition.

Detailed description of the preferred embodiments

Referring firstly to Figure 1, there is shown a first embodiment of a retractable syringe 10 according to the invention. The syringe 10 has a barrel structure 20 having a generally cylindrical hollow syringe barrel 40 defining a cylindrical barrel interior 46. The barrel is open at a rear end 54 and closed at a forward end 52 by a transverse closure portion 50.

A syringe plunger 30 is inserted into the cylindrical barrel interior 46 from the rear end 54 of the barrel 40. The plunger 30 has an elongate syringe body portion 32 with a forward annular seal member 140, which slidingly and sealingly engages the inner surface of the cylindrical barrel 46.

The barrel structure 20 has an annular retaining structure 100 positioned in the cylindrical barrel 40, in abutting contact with an inner, rear, transverse inner face 55 of closure portion 50. To facilitate retention of the annular retaining structure 100 in the barrel interior 46, the inner surface 48 of the cylindrical barrel has a circumferential ridge 196, positioned such that when the annular retaining structure is placed in position by entry of it into the cylindrical barrel 40, from the rear end 54 of the barrel 40, the annular retaining structure 100 must be slid past this, under some resilient deformation of the structure 100, such that the circumferential ridge 196 is in the assembled condition of structure 100 is positioned immediately behind the structure 100, as shown.

The closure portion 50 has an axial needle accommodating opening 56 therethrough. The retaining structure 100 has an aligned retaining structure opening 106 therethrough. A needle structure 70 is retained in openings 56, 106 so that a needle 72 thereof extends forwardly from the syringe barrel structure 20, permitting fluid flow from the cylindrical barrel 46, through the needle structure 70. By this, fluid in the cylindrical barrel between the retaining structure 100 and the seal member 140 may be forced from

the chamber through the needle structure to exit via a skin penetration forward end 74 of the needle 72.

The opening 56 has a smaller diameter first portion 58, leading inwardly from the forward extremity of the closure portion 50 and a larger diameter second portion 60 leading forwardly from the inner face 55 of closure portion 30. These portions 58, 60 join at a step 122.

The needle structure 70 has, towards the end thereof remote from end 74, an outwardly extending abutment portion 76, formed as an outstanding annular flange. A helical compression spring 80 is positioned in portion 60 of opening 56, so as to be between step 122 and abutment portion 76. The diameter of the spring 80 is greater than the diameter of the portion 58 of opening 56, but somewhat less than the diameter of portion 60 of opening 56. The inner diameter of the spring is somewhat greater than the diameter of the needle 72, which portion passes through the spring, but less than the diameter of the abutment portion 76.

In the condition shown in Figure 1, the spring 80 is in a substantially fully compressed condition. That is to say, the successive helical convolutions of the spring 80 are substantially in axial contact with each other such that further compression of the spring is substantially inhibited. The largest diameter of the needle structure 70, at abutment portion 76, and the diameter of spring 80 are both less than the diameter of opening 106 through retaining structure 100. Under resilient bias of the spring 80, acting between the step 122 and abutment portion 76, the needle structure 70 and spring 80 may move rearwardly through the openings 56, 106. However, the spring 80 is held in the compressed condition by action of a holding means or expandable annular member in the form of a resilient O-ring 90 retained in opening 106.

Opening 106 through retaining structure 100 has, adjacent a forward transverse surface 104 of the annular retaining structure 100, and adjacent the inner face 55 of closure portion 50, a larger diameter first portion 112. First portion 112 is of diameter greater than the 25 outside diameter of the O-ring 90 in its uncompressed state, such as to permit the O-ring 90 in its uncompressed state to be freely accommodated therein.

At the rearmost end of annular retaining structure 100, opening 106 has a smaller diameter second portion 114 communicating with a rear transverse surface 108 of the structure 100. The diameter of second portion 114 is less than the diameter of the O-ring 90 in its compressed state. Between portions 112, 114 of opening 106, opening 106 has an intermediate portion 116 of diameter intermediate between the diameters of portions 112, 114. The O-ring 90 is accommodated in intermediate portion 116. The diameter of the intermediate portion 116 corresponds to the outside diameter of O-ring 90, in its compressed state, so that the O-ring 90 is retained in the intermediate portion 116 by frictional engagement with the periphery thereof. More particularly, as shown, the O-ring is so retained, while being urged by spring 80 against a step 120 between portions 114, 116 of the opening 106.

The needle structure 70 has, between abutment portion 76 and the inner end of the needle structure, a cylindrical end portion 78. The end portion 78 passes into the interior opening of the O-ring 90, and has a diameter such that it is resiliently gripped by the O-ring when the O-ring 90 is in its compressed state. This gripping is such as to prevent the spring 80 from urging the needle structure 70 through the O-ring 90 and the annular retaining structure 100. Alternatively, or additionally, such movement may be constrained because the abutment portion 76 is of greater diameter than the internal diameter of the O-ring and resiliently bears against the O-ring 90. In any event, release is effected as next detailed by forwardly expressing the O-ring 90 through an annular gap 128 (see Figures 4 and 5) between the periphery of the abutment portion 76 and a peripheral edge 132 in the opening 106, at the junction between the portions 112, 116 thereof.

The syringe body portion 32 is in the form of an axially extending tube of diameter substantially less than the diameter of cylindrical barrel 40 of barrel structure 20. The body 32 extends forwardly from a rear end of the plunger 30 and defines an inner chamber 34. Outwardly extending opposed portions 37 are provided on the body portion 32, at the rear end, to facilitate exertion of manual pressure on the plunger 30 for moving it towards the forward end of the syringe barrel structure 20. The rear end, the inner chamber 34 of the body portion 32 is closed by insertion thereinto of a plug 160. At the forward end, an opening or axial hole 36 of the syringe plunger and inner chamber 34 is

defined by the body portion 32. The opening 36 is closed by a frangible transversely extending wall 38.

In order to provide rigidity, and to assist in guiding the plunger 30 in its movement in barrel 40 the plunger 30 is provided with radial ribs 39 extending outwardly of body 32, and between wall 156 and outwardly opposed portions 37 (see Figure 7).

The seal member 140 is retained on a forward end portion 144 of the body portion 32 of the plunger 30, the latter extending through an axial opening 152 in the seal member. The opening 152 is dimensioned such that the seal member, which is made of resilient material, firmly grips the body 32. Movement of the seal member 140 axially with respect to the body portion 32 is further inhibited by provision on the forward end portion 144 of body portion 32 of an external peripheral ridge 154 that engages with the interior surface of the seal member 140, in the opening 152, and by a transverse wall 156 formed on forward end portion 144, and against which the seal member 140 abuts. In that regard, the seal member 140 is fitted to the plunger by passing the seal member over the forward end portion of the body portion 32, until the seal member 140 is brought into abutting relationship with the wall 156. An abutment portion 26 of the plunger 30 is formed by a part of the body 32 that extends forwardly of the seal member 140, in the assembled condition shown. As previously noted, the abutment portion 26 is closed at the forward end (i.e. adjacent the opening 36) by the frangible wall 38.

The interior of the body 32 of plunger 30 defines an elongate inner chamber 34 bounded at the forward end by the wall 38 and at the other by plug 160. This cavity is proportioned such that the spring 80 and the needle structure 70 can be accommodated within it, when the needle structure 70 and the spring 80 move rearwardly on release of the spring 80.

The forward surface 158 of seal member 140 is somewhat convexly conical and the rear transverse surface 108 of the annular retaining structure 100 is concavely formed, and of complimentary conical configuration. The abutment portion 26 is of external diameter somewhat less than the diameter of second portion 114 of annular retaining structure opening 106, and of length somewhat more than the axial length of second portion 114 of opening 160.

The operation of the retractable syringe 10 is as follows:

1. With the syringe 10 in the condition shown in Figure 1, the end 74 of the needle 72 is placed in a body of fluid to be injected, and fluid is drawn into the cylindrical barrel interior 46 by withdrawing the plunger 30.

2. After withdrawal of the needle 72 from the body of fluid to be injected, the syringe 10 is manipulated so as to cause the end 74 of the needle 72 to pass through the skin of a person to be injected, and the plunger 30 moved forwardly to inject fluid from the interior 46 into the person via the needle structure 70.

3. At the close of injection, the seal member 140 moves adjacent the annular retaining structure 100, and the wall 38 on the abutment portion 26 of the plunger 30 engages the inner end of the needle structure 70, thereby breaking the periphery of the wall 38 away so as to open the inner chamber 34 of the plunger 30.

4. Immediately before further forward movement of the plunger 30 is precluded by engagement of the surfaces 158 and 108 respectively on the annular retaining structure 100 and seal member 140, the forward end of the abutment portion 26 engages the rear of the O-ring 90. The O-ring 90 is then pressed forwardly by the abutment portion 26, and expressed through the gap 128, whereafter it is freed from radial compression and expands to its rest state, in the first portion 112 of opening 106. The position of the O-ring immediately after movement of the O-ring is shown in Figure 2, and in more detail in Figures 4 and 5.

5. Pursuant to movement of the O-ring 90 into the first portion 112 of the opening 106, the needle structure 70 and the spring 80 are freed from retention by the O-ring 90, and the spring 80 urges the needle structure 70 inwardly through opening 36 in the forward end of the plunger 30 and, as shown in Figure 6, and into the chamber 34. The spring 80 follows into the chamber 34. The resultant final condition of the syringe 10 is shown at Figure 3.

The described construction is very convenient in use. The described retraction action is effective to withdraw the needle structure 70 and the spring 90 into the chamber 34 as a final part of the injection procedure. Because the spring 80 is substantially fully compressed in the loaded state, little forward movement of the needle structure 70 occurs when the O-ring 90 is engaged and moved into the first portion 112. Also, the syringe 10 can be simply manufactured.

In manufacture, the syringe barrel structure 20, the annular retaining structure 100 and the seal member 140 may be moulded from plastics as respective single mouldings. The syringe plunger except for the seal member 140 and plug 160 may likewise be formed as a single moulding. The plug 160 can be separately formed, or, alternatively can be formed in the manner shown in Figures 10 and 11, particularly as two plug element 170, 172, respectively formed integrally with arms 176, 178 integrally and hingedly connected to the outer ends of the outwardly extending opposed portions 37 of the syringe plunger 30. By this, after moulding, the arms 176, 178 may be swung about the hinge points 180, 182, to enter the plug elements into the open end of the body portion 32, so that they cooperate to seal the rear end of the chamber 34. The spring 80 may be formed as a conventional compression spring, eg. from stainless steel. The needle structure 70 can be formed from a length of hollow needle material, with the abutment portion 76 formed as a plastics moulding, located towards one end of that length. To facilitate gripping by the O-ring 90, the end portion 78 of the needle structure 70 may be formed as a larger diameter plastics moulding around the end of the needle length, possible integrally formed with abutment portion 76. The O-ring 90 may be formed by moulding in, eg. neoprene.

Having formed the components as last described, the syringe 10 may be assembled as follows:

1. Assembling the seal member 140 to the forward end of the body portion 32, by passing the latter through the opening 152 in the seal member 140, until the seal member 140 engages the transverse wall 156.

2. Inserting the plug 160 into the outer end of the body portion 32 or, in the

case of the arrangement of Figures 10 and 11, swinging the arms 176, 178 to enter the plug elements 170, 172 into that outer end.

3. Assembling the spring 80 on the needle structure 70.

4. Radially compressing the O-ring 90 and positioning it within the portion 116 of opening 106 in retaining structure 100.

5. Inserting the needle structure 70 into the cylindrical interior 46 of the barrel 40, from the rear end 54, so that the needle 72 passes through needle accommodating opening 56 in the closure portion 50 of barrel structure 20, and spring 80 is entered into second portion 60 of the needle accommodating opening 56.

6. Inserting the annular retaining structure 100 into the cylindrical barrel 40, and sliding it forwardly so that the forward transverse surface 104 thereof abuts the inner face 55 of the closure portion 50 of the barrel structure 20, and the rear transverse surface 108 is positioned immediately in front of the circumferential ridge 196. During this action, the O-ring 90 is compressed and moved rearwardly to be accommodated in the intermediate portion 116 of retaining structure opening 106, and the spring 80 is compressed by forward movement of the innermost end thereof by force exerted by the forward movement of the retaining structure 100, via the O-ring 90 and the abutment portion 76 of the needle structure 70.

After these steps are completed, the plunger 30 may be inserted into the cylindrical interior of the barrel 40.

The sequence of these steps may be varied. For example, the spring 80 may be positioned in second portion 60 of needle accommodating opening 56 without having first passed this over the needle structure 70, with the needle structure 70 being subsequently entered into the spring 80 and needle accommodating opening 56. Also, the O-ring may be positioned in the intermediate portion 116 of the opening 106 in the retaining structure 100, so that the end portion 78 of the needle structure is entered into the O-ring when the annular retaining structure 100 is advanced forwardly in the barrel 40.

Figures 10 and 11 show a second embodiment of a retractable syringe 10′ according to the invention. The syringe 10′ is similar to the syringe 10 and like features are indicated with like reference numerals. However, in the syringe 10′ the opposed portions 37 of the body portion 32 have rearwardly extending posts 184, 186 each having an axially inwardly directed catch portion 188, 190. The catch portions 188, 190 are arranged such that, at the end of inward movement of the plunger 30 to effect injection, the ends of portions 37 adjacent hinge points 180, 182, engage and resiliently outwardly deflect the catch portions 188, 190, so resiliently outwardly deflecting posts 184, 186. The posts revert, under natural resilient bias, to the rest condition after passage of the portions 37 past the catch portions 188, 190, so as to capture the syringe plunger and prevent withdrawal of it from the barrel 40. Figure 11 illustrates the latter condition.

Figure 12 shows a third embodiment of a retractable syringe 10″ according to the invention. The syringe 10″ is similar to the syringe 10 and like features are indicated with like reference numerals. Differences in the syringe 10″ and the syringe 10 are described below.

Firstly, in the syringe 10″, the needle structure 70 has, towards the end thereof remote from the forward end 74, an outwardly extending abutment portion 276, formed as an external annular flange. The needle structure 70 also has a needle mount portion 278 joining the needle 72 to the abutment portion 276. The external diameter of the needle mount portion 278 is sized to be a snug fit within the needle accommodating opening 56 in the barrel structure 20. This advantageously reduces movement of the needle 72 relative to the barrel structure 20. This improves accuracy of needle placement and also permits a single barrel structure 20 to be used with a variety of different needle gauges, provided the gauge of the needle 72 is smaller diameter then the (constant diameter) needle mount portion 278.

Further, in the syringe 10″, the O-ring 290 has a cylindrical exterior surface 290a in order to approve its sealing in the intermediate portion 116 of the retaining structure 100.

Also, the plunger 30 in the syringe 10″ is primarily produced from polypropylene, except for a forwardly convex member 230 formed from a relatively

brittle acrylic. The member 230 is comprised of a distal cylindrical portion 232, a flange 234, a proximal cylindrical part 236, and a leading nose portion 238. The nose portion 238 is joined to the proximal cylindrical portion 236 by a weakened region 240. The nose portion 238 is adapted to fracture and thus open the inner chamber 32 in the plunger 30, in a similar manner to the wall 38 of the syringe 10.

The plunger 230 has a recessed shoulder 242 adapted to receive the distal cylindrical portion 232 therein and a flange 244 corresponding to the end portion flange 234. The seal member 140 in the syringe 10" has a recess 246 that corresponds in shape to that of the two flanges 234, 242 and which thus acts to hold the member 230 and the plunger 30 together. The exterior of the seal 246 provides a seal against the interior of the barrel 20 structure in a similar manner to the syringe 10. The interior of the seal 246 also provides a seal between the end portion 232 and the plunger 230 to prevent any injected liquid entering the plunger interior 34.

The distal end of the plunger 30 in the syringe 10" also has an internal taper 250 which, after use of the syringe 10", acts to engage the flange 276 of the needle structure and retain same within the plunger 30.

Finally, the plunger 30 in the syringe 10" has a reduced external diameter compared to that of the syringe 10. This allows the internal diameter of the O-ring 290 to be increased, which improves its grip on the end portion 78 of the needle structure 70. This advantageously results in an increase in needle tip pressure, thereby reducing the likelihood of premature needle release.

The needle 10" is assembled, and operates, in a similar manner to that of the syringe 10 with the nose portion 238 failing around the weakened region 240 when pressed against the needle structure end portion 78 to allow the plunger to release the O-ring 90, and thus the needle structure 70, as previously described.

Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that that prior art forms part of the common general knowledge in Australia.